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NIGHT EVALUATION OF A RADIO-LUMINESCENT PISTOL SIGHT

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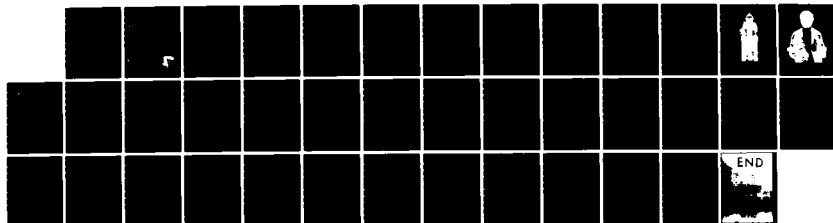
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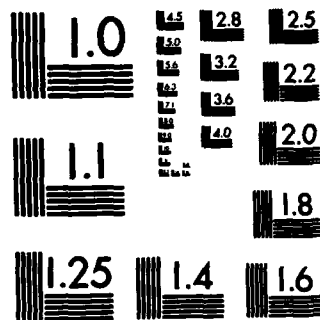
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AFATL-TR-84-10

Night Evaluation of a Radio-Luminescent Pistol Sight

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John C Robbins

GUNS AND ROCKETS BRANCH
MUNITIONS DIVISION

JANUARY 1984

FINAL REPORT FOR PERIOD DECEMBER 1981 - NOVEMBER 1983

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20. ABSTRACT. (CONCLUDED)

There was some inclination in the data which tended to favor the night sights but there was no statistically significant superiority.

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PREFACE

This evaluation was conducted by the Guns and Rockets Branch, Direct Fire Weapons Division (now Munitions Division), Air Force Armament Laboratory, Eglin Air Force Base, Florida. Mr. John C. Robbins and Lt Richard Moore managed the program. All firing and scoring was done during the month of December 1981.

The Public Affairs Office has reviewed this report, and it is releasable to the National Technical Information Service (NTIS), where it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Milton D. Kingcaid
MILTON D. KINGCAID, Colonel, USAF
Chief, Munitions Division



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SECTION I

The Air Force is a participant in the Joint Services Small Arms Program (JSSAP). Under the JSSAP, the Air Force is assigned primary responsibility for personal defense weapons, which are generally sidearms (handguns). As part of this responsibility, the Air Force undertook to conduct a joint service evaluation of radio-luminescent pistol sights (hereafter referred to as night sights) to determine how much, if any, they would enhance hit and kill probability under night time conditions on a simulated stressed combat course.

The evaluation was conducted at night in and about an abandoned building on a remote area of the Eglin Air Force reservation. Ten targets were used at ranges of 14 to 150 feet. They were electronically controlled and scored such that they would appear by swinging out or up. Some of these targets could also "shout" and "fire" at the shooter when appearing and "die" when hit by returning to their original, concealed position.

It was planned to have 16 journeyman level shooters, four each from the Army, Navy, Marines, and Air Force. The Navy was only able to provide three shooters and two of the Marines were recalled before the scoring got underway, so the evaluation was done with 13 shooters. The shooters who fired for record and their parent organizations are identified in Table 1.

The guns utilized were essentially identical 9 mm Beretta Model 92S pistols with and without radio-luminescent sights front and rear.

TABLE 1. PARTICIPATING PERSONNEL

CODE	GUN NBR	NAME	GRADE	UNIT	PHONE (AV)
AF1	1	Pierzchanowski, Philip	SRA	3201SPS/Eglin AFB FL	872-5304
AF2	2	Scott, Lindsey	A1C	3201SPS/Eglin AFB FL	872-2502
AF3	3	Scott, Karen	A1C	3201SPS/Eglin AFB FL	872-8051
AF4	4	Skowrya, Chris	A1C	3201SPS/Eglin AFB FL	872-2502
AR1	5	Huthmacher, Charles	SSgt	A Co Sch Bn/Ft McClellan AL	865-4383
AR2	6	Ridley, Jay	Sgt	A Co Sch Bn/Ft McClellan AL	865-4383
AR3	7	Koenck, James	SSgt	A Co Sch Bn/Ft McClellan AL	865-4383
AR4	8	Ferriss, Janice	SSgt	Co A MP Sch Bn/Ft McClellan A1	865-4383
MC1	9	Powell, Gayle	Sgt	Scty Bat MPCO/Quantico VA	278-2258
MC2	10	Hampton, Janet	Cpl	Scty Bat MPCO/Quantico VA	278-2258
NC1	13	Hentzen, John	MM1	SPEC WAR GUN 2/Little Creek VA	680-7715
NC2	14	Tickle, Linda	SA	SPEC WAR GUN 2/Little Creek VA	680-7715
NC3	15	Adams, James	GMC	RTC/Yorktown VA	827-2334

SECTION II

DISCUSSION

A. DESCRIPTION OF ITEM

The subject of this evaluation was a pair of radio-luminescent light sources mounted in the front and rear sights of 9 mm Beretta Model 92S pistols. These light sources were provided by Nite-Site Inc., Rosemont, Minnesota 55068. According to their literature:

"The self luminous portion of (the) sighting system consists of the radioactive element Promethium (PM147) mixed with a phosphor and encapsulated in an epoxy."

The plastic cylinders are 0.77 inch in diameter and are located near the top of the front sight and immediately below the notch in the rear sight. Figure 1 illustrates the pistol with these inserts in place. The dots are unobtrusive during daylight and are clearly visible at night. This particular brand of sights was chosen simply because they were expected to be typical of radioluminescent sights, and therefore a suitable subject for evaluation. Promethium has a half-life of 2.6 years.

B. DESCRIPTION OF TARGETS

The course of fire for this evaluation was laid out in an abandoned building in a remote area of the Eglin reservation. It consisted of ten three-dimensional half targets, each of which appeared upon command of the range director. Some targets "shot" and/or "shouted" at and "died" when hit. The "shouts" were recordings played through a speaker at the target location. The "firing" consisted of firing two squibs which simulated both noise and muzzle flash. The target equipment was provided by Caswell Equipment Company, Inc., Minneapolis, Minnesota. Time to hit was automatically recorded from the time the range director activated each target until it was hit.

Figure 2 illustrates a typical target face. Figures 3 and 4 show the general layout of the building, grounds, target location, and firing positions that were used throughout the evaluation. Specific targets were:

Target 1: Fourteen feet range, half silhouette down a ramp, located under the edge of a building to the side of a stairway. Target swings out, shouts and fires at shooter. Target is in the dark, "muzzle flash" is visible.

Target 2: Twenty-one feet range, target pops up from behind a desk diagonally across a room to the left of shooter. Room is dimly lit. Double hits required.

Target 3: Twenty-four feet down a hall and off to the right in a small room. Target swings out into the doorway and shouts at shooter. Room is dimly lit.

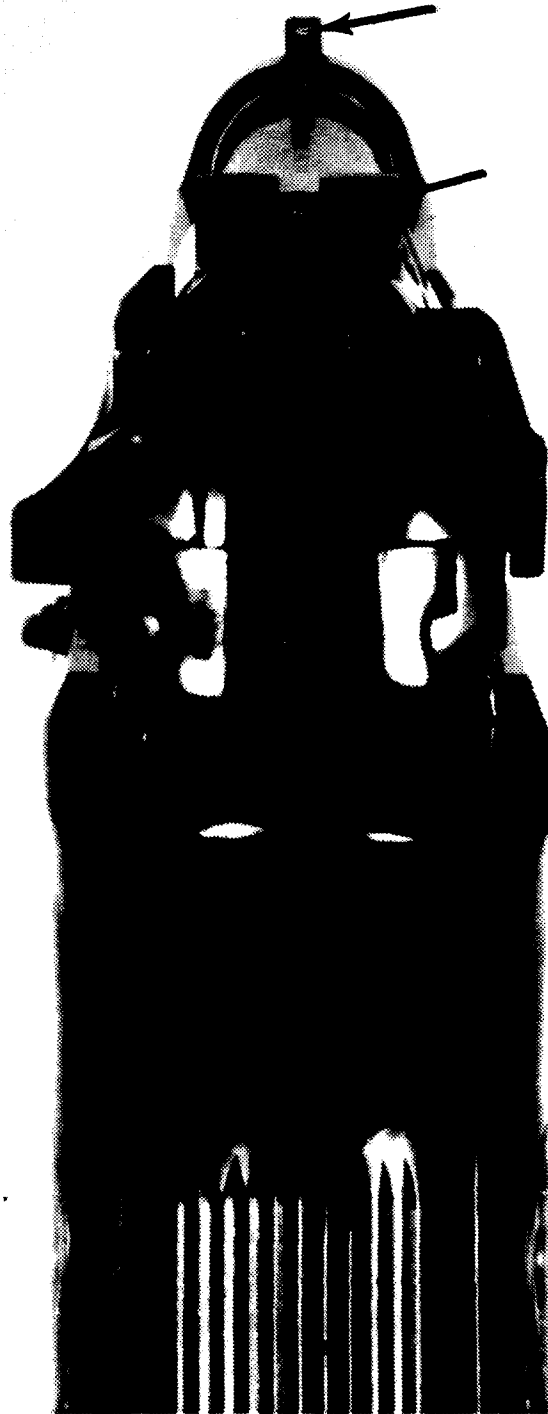


Figure 1. Sight Installation (Arrows point to radio luminescent light source)



Figure 2. Typical Target

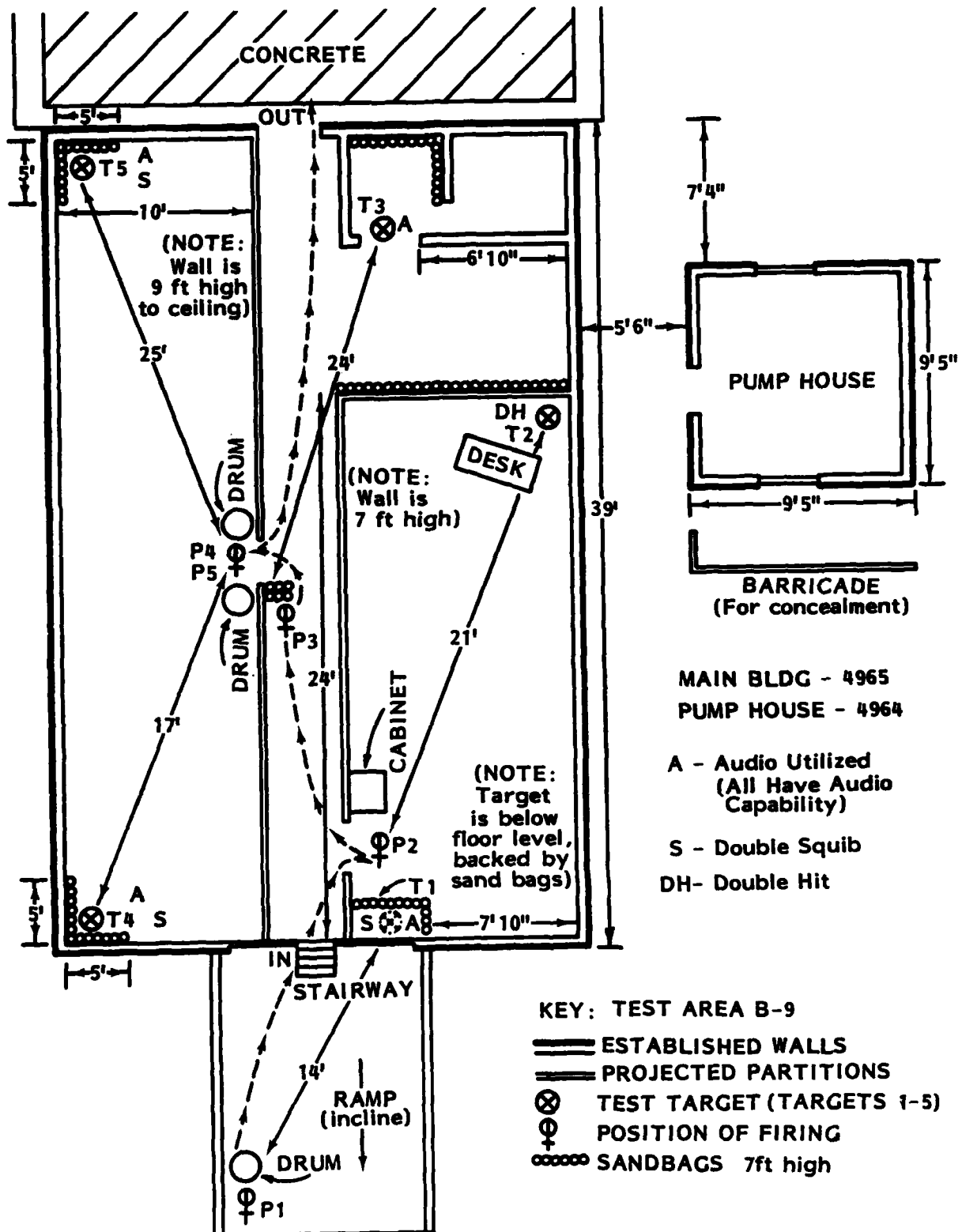


Figure 3. Layout of Targets 1-5

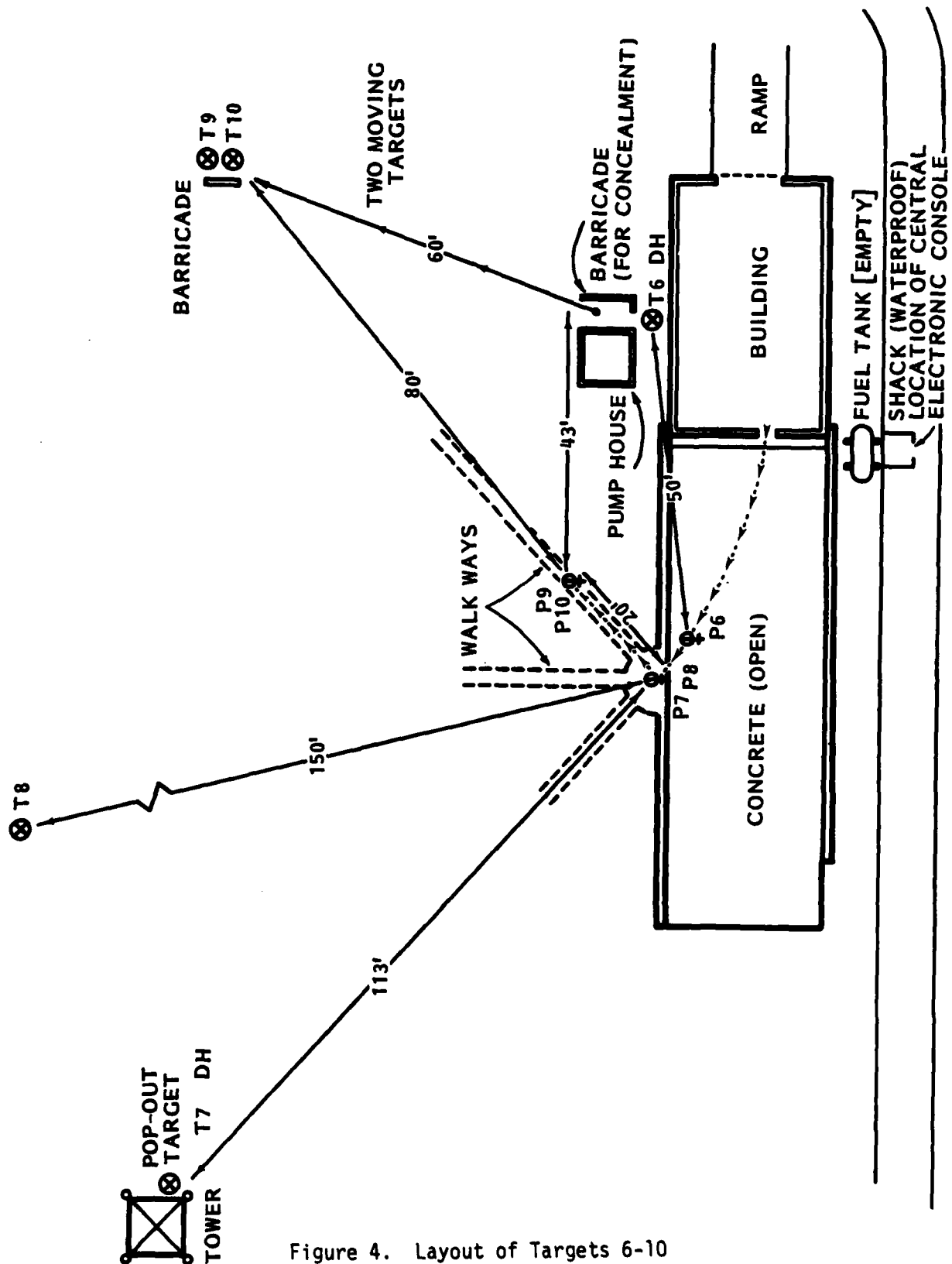


Figure 4. Layout of Targets 6-10

Target 4: Seventeen feet range, sharply to the left diagonally across room from door. Shooting position just inside door from previous position. Target swings to face, shouts, and fires at shooter. Room is dark but target is discernable.

Target 5: Twenty-five feet range, fired from same location as previous target, in the same room but sharply to the right. Target swings to face, shouts, and fires at shooter. Room is dark but target is discernable.

Target 6: Fifty feet range, fired from outside in the open, sharply back to the right. Target swings out from behind a building. Double hit required.

Target 7: One hundred thirteen feet range, target swings out from behind leg of wooden tower into dimly lighted area. Two hits required.

Target 8: One hundred fifty feet, open terrain, pops up in dimly lighted area.

Targets 9 and 10: Two running targets passing diagonally from right to left, moving from 43 feet range to 80 feet range while traversing 60 feet at 12 feet per second.

C. EVALUATION METHOD

Prior to any firing for record, each of the 13 (originally 15) shooters was given several days of familiarization and proficiency training with the Beretta Model 92S pistol. This training consisted of 2 days familiarization and general range practice followed by 3 days combat training on pop-up targets of the general type used on the evaluation course. Although these shooters were considered journeyman level before this training period, they were well above average at its conclusion. Few military personnel ever get 5 consecutive days of intensive pistol training.

The first time the shooters saw the actual evaluation range they went through it for record. It was scheduled that eight shooters would use the standard sights on their first course and seven would start out with the night sight; however, the two Marines who were unable to complete the course were scheduled to begin with night sights so the final record had eight beginning with standard sights and five with night sights.

The procedure, followed each of the 78 times the course was run, was as follows. The range had previously been set up, squibs wired, and everything ready. The shooter was delivered to the range from a control point over a mile away. The driver left the range area, leaving the shooter and range director. When the driver reached the control point, he radioed the range director that the range was clear. The shooter and range director had meanwhile checked out the timers, etc., in the electrical equipment shack (bottom right, Figure 4). Once the range was clear, the shooter loaded his gun and he and the range director walked off to the right along a luminous white paint stripe toward the first target, shooter leading and range director immediately behind. The shooter followed the range director's instructions, and when he (shooter) was in the desired position the range director activated the target from a hand held radio control. This actuation moved the target into position, caused it to appear and, if so

mechanized, to also "shout" and/or "fire", and initiated a timer. The shooter, carrying his gun at ready, was free to fire at will. When he hit the target (once or twice as required), the timer for that target stopped and the time was recorded on the console. This was repeated for all 10 targets in sequence as illustrated in Figures 3 and 4, at which time the shooter and range director checked the console and recorded target times. The shooter and range director then rewired the squibs and reset the targets and timers as required for the next shooter. The range director then radioed the control point to bring in the next shooter and pick up the one just finished. This procedure was continued during the hours of darkness for a full week until 78 passes (780 targets) were completed.

There was some difficulty with the reliability of targets. On occasion the shock of opening a target (pop up or swing out) would trigger a "hit" (too sensitive), and on other occasions hits would not record (not enough sensitivity). These spurious times were deleted from the firing record as were gun jams and reload time.

D. DATA AND SCORING

The tabulated kill time for each of the shooters against each of the targets for all courses of fire are presented in Tables 2 through 14. The average time required for each shooter to kill each target was calculated and is shown at the bottom of these tables.

In order to condense this data into a usable form, the average score for each shooter for each target was tabulated in Table 15. The targets for which the individual shooters did not have valid scores were marked with an X. The targets for which the individual shooter did not have a valid comparison score with the other type sights were marked with a slash through that score. All valid scores with valid comparisons were then added and averaged both horizontally and vertically and observations made.

Since no clear cut superiority for either sight system was obvious, another tabulation was made of the sums of the average scores for the first five (shorter range) targets and the last five (longer range) targets. These data are given in Table 16.

A specific look was taken at the two longest range targets where it was expected that any sight superiority would be evident, and also at the running targets which, in a large number of cases, were clearly missed.

Some individuals were of the impression that if either sighting system were clearly superior it should be obvious on the first time through the course, before the shooters became familiar with the course. Table 17 is the first and second run data for those shooters who shot the course first with night sights. Table 18 is like data for those who started with standard sights.

E. RESULTS

Upon examining this data from many perspectives, several statements of fact can be made in the form of results:

TABLE 2. INDIVIDUAL KILL TIME CODE AR1

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	2.2	1.8	1.7	1.2	1.4	4.0	7.6	3.5	2.0	X
3	X	2.1	X	1.4	0.5	2.2	2.4	6.2	1.4	1.4
5	1.8	1.8	1.6	1.0	1.9	2.7	16.3	34.9	1.9	X
AVG	2.0	1.9	1.65	1.2	1.3	3.0	8.8	14.9	1.77	1.4

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	2.7	2.3	1.9	1.8	1.4	4.7	12.9	5.9	1.6	X
4	1.7	1.5	X	1.4	1.1	2.3	1.5	2.3	X	4.0
6	2.4	2.0	2.3	X	1.3	3.7	2.1	10.2	1.9	X
AVG	2.27	1.93	2.1	1.6	1.27	3.6	5.5	6.13	1.75	4.0

X = No Valid Score

TABLE 3. INDIVIDUAL KILL TIME CODE AR2

STANDARD SIGHT										
TARGET										
RUN	1	2	3	4	5	6	7	8	9	10
2	3.8	3.8	2.9	2.0	1.0	3.9	3.7	9.6	3.1	X
4	X	1.4	X	0.0	0.3	3.8	3.0	2.4	1.8	1.8
6	X	1.4	2.1	0.9	0.6	4.0	2.1	2.5	X	X
AVG	3.8	2.2	2.5	1.23	0.63	3.9	2.93	4.83	2.45	1.8

NIGHT SIGHT										
TARGET										
RUN	1	2	3	4	5	6	7	8	9	10
1	X	3.6	2.5	X	X	2.7	X	6.0	1.8	2.7
3	X	2.1	X	0.0	0.7	2.1	5.1	3.1	1.7	1.7
5	2.0	1.5	1.6	X	1.0	2.9	4.2	4.7	1.8	X
AVG	2.0	2.4	2.5	0.8	.85	2.57	4.65	4.6	1.77	2.2

X = No Valid Score

TABLE 4. INDIVIDUAL KILL TIME CODE AR3

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	5.9	2.0	0.9	0.3	0.7	2.1	5.1	3.3	1.8	X
3	0.9	1.0	X	1.1	1.0	1.8	2.5	1.9	1.1	1.1
5	1.5	1.2	0.8	1.1	0.9	1.7	1.0	1.9	2.4	X
AVG	2.77	1.4	.85	.83	.87	1.87	3.1	2.37	1.77	1.1

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	1.5	2.2	1.2	1.6	1.5	4.0	3.1	3.4	2.3	1.8
4	X	1.4	X	1.2	0.9	2.6	2.7	1.4	1.2	2.3
6	X	1.6	0.9	1.5	0.8	2.1	1.2	1.5	1.4	X
AVG	1.5	1.73	1.05	1.43	1.07	2.9	2.33	2.1	1.63	2.05

X = No Valid Score

TABLE 5. INDIVIDUAL KILL TIME CODE AR4

STANDARD SIGHT

	TARGET									
RUN	1	2	3	4	5	6	7	8	9	10
2	X	2.2	2.1	0.3	0.7	3.9	5.5	2.4	1.7	X
4	4.6	1.6	X	1.4	2.3	1.3	1.7	7.9	2.2	1.2
6	2.3	1.2	0.9	1.1	1.0	1.7	1.8	1.9	1.2	1.7
AVG	3.45	1.67	1.0	.93	1.33	2.3	3.0	4.07	1.7	1.45

NIGHT SIGHT

	TARGET									
RUN	1	2	3	4	5	6	7	8	9	10
1	3.7	2.2	X	1.5	0.8	4.3	3.2	10.2	1.4	1.4
3	0.8	1.5	X	0.8	0.6	0.9	3.01	4.0	1.2	2.9
5	2.0	1.1	0.8	1.1	1.1	0.8	6.6	1.8	1.0	X
AVG	2.17	1.6	0.8	1.13	.83	2.0	13.3	5.33	1.2	2.15

X = No Valid Score

TABLE 6. INDIVIDUAL KILL TIME CODE NC1

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	2.2	2.2	2.0	1.3	1.0	3.0	7.0	6.4	2.5	2.5
3	0.7	1.3	X	0.7	0.0	1.6	2.9	7.3	1.2	1.6
5	4.4	3.0	1.2	0.7	0.7	2.7	2.4	1.7	2.5	X
AVG	2.43	2.17	1.6	0.9	.83	2.43	4.1	5.13	2.07	2.05

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	1.3	1.7	1.5	0.7	1.1	3.1	10.5	3.3	3.1	2.8
4	1.4	1.1	X	0.7	0.7	0.8	14.9	3.3	11.3	3.3
6	1.7	1.0	0.9	0.7	0.7	1.4	1.8	5.3	1.1	X
AVG	1.47	1.27	1.2	0.7	.83	1.77	9.07	3.97	1.83	3.05

X = No Valid Score

TABLE 7. INDIVIDUAL KILL TIME CODE NC2

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	0.8	2.1	2.1	1.1	0.8	3.8	X	12.0	X	X
4	0.6	1.1	x	1.0	0.4	25.8	X	X	X	2.2
6	X	1.5	3.7	1.7	0.6	1.4	X	X	X	X
AVG	0.7	1.57	2.9	1.27	.6	10.3	X	12.0	X	2.2

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	1.7	2.6	2.0	2.4	1.2	4.9	X	X	X	X
3	0.7	1.0	X	X	1.1	1.8	5.1	X	X	X
5	X	1.2	3.3	1.4	0.5	2.2	X	X	2.1	X
AVG	1.2	1.6	2.65	1.9	.93	2.97	5.1	X	2.1	X

X = No Valid Score

TABLE 8. INDIVIDUAL KILL TIME (SEC) CODE NC3

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	1.9	1.9	1.6	1.5	1.5	X	4.3	35.3	1.7	2.7
3	0.6	1.6	X	0.9	0.8	X	9.1	3.7	1.8	2.1
5	0.8	1.3	1.0	1.0	1.1	2.7	3.4	5.9	1.4	X
AVG	1.1	1.6	1.3	1.13	1.13	2.7	5.6	14.97	1.63	2.4

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	0.4	1.7	1.5	0.8	1.5	2.4	3.8	5.5	1.1	X
4	1.0	1.2	X	0.8	0.7	1.0	1.2	X	1.2	1.8
6	1.3	1.5	1.3	0.9	0.3	2.0	3.3	4.1	1.5	3.8
AVG	0.9	1.47	1.4	.83	.83	1.8	2.77	8.13	1.27	2.7

X = No Valid Score

TABLE 9. INDIVIDUAL KILL TIME (SEC) CODE AF1

STANDARD SIGHT										
TARGET										
RUN	1	2	3	4	5	6	7	8	9	10
1	2.7	1.9	1.5	1.4	1.1	X	7.9	5.6	1.7	X
3	1.1	1.4	X	1.1	0.9	14.7	X	3.4	3.0	2.0
5	1.8	1.3	2.0	1.0	1.1	2.3	4.2	2.4	X	X
AVG	1.87	1.53	1.75	1.17	1.03	8.5	6.05	3.8	2.35	2.0

NIGHT SIGHT										
TARGET										
RUN	1	2	3	4	5	6	7	8	9	10
2	1.1	1.7	1.9	1.6	0.9	X	X	6.6	1.4	1.4
4	X	1.3	X	1.2	0.8	1.7	5.5	2.2	1.3	2.0
6	1.9	1.3	1.8	0.9	0.9	5.5	9.0	16.2	2.5	2.0
AVG	1.5	1.43	1.85	1.23	.83	3.6	1.25	8.33	1.73	1.9

X = No Valid Score

TABLE 10. INDIVIDUAL KILL TIME (SEC) CODE AF2

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	0.7	1.5	1.1	1.4	0.9	2.5	1.9	2.1	1.9	X
4	2.5	1.7	4.9	2.8	4.3	11.5	2.0	28.9	2.2	X
6	1.5	1.3	0.9	1.1	1.2	5.0	9.4	30.8	3.7	X
AVG	1.57	1.5	2.3	1.77	2.13	5.87	4.43	20.6	2.6	X

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	X	2.7	1.3	1.4	X	2.2	4.9	7.1	2.1	2.1
3	X	1.5	X	0.9	1.5	X	X	5.9	2.8	2.8
5	X	1.6	1.6	1.7	1.1	2.8	4.0	34.2	1.3	2.4
AVG	X	1.93	1.45	1.33	1.3	2.5	4.45	15.7	2.07	2.43

TABLE 11. INDIVIDUAL KILL TIME (SEC) CODE AF3

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	1.0	4.1	3.0	5.7	0.7	8.2	8.5	47.5	X	X
3	X	3.1	5.3	4.6	2.3	33.9	12.7	14.1	X	X
AVG	1.0	3.6	4.15	5.15	1.5	21.0	10.6	30.8	X	X

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	X	3.4	2.9	9.9	3.6	X	21.0	10.5	X	X
4	X	2.5	9.7	3.4	4.9	6.6	10.3	27.1	X	X
AVG	X	2.95	6.3	6.65	4.25	6.6	15.65	18.8	X	X

TABLE 12. INDIVIDUAL KILL TIME (SEC) CODE AF4

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	1.3	1.8	1.2	1.3	0.9	X	X	X	X	X
4	1.7	2.3	X	1.0	0.8	2.9	22.2	2.9	X	3.1
6	1.8	1.6	X	0.8	0.7	1.1	X	33.9	X	X
8	X	1.9	X	0.8	0.7	7.3	8.0	33.4	X	X
AVG	1.6	1.9	1.2	.98	.78	3.77	15.1	23.41	X	3.1

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	1.9	2.3	0.9	1.2	0.7	3.3	6.2	31.9	X	X
3	0.8	1.9	0.7	4.2	1.3	2.9	14.0	35.9	X	X
5	3.0	3.0	X	1.0	0.8	2.1	29.0	6.8	X	X
7	0.8	1.0	X	0.7	0.7	3.4	17.8	10.2	X	v
AVG	1.63	2.05	0.8	1.78	.87	2.93	16.75	21.2	X	X

TABLE 13. INDIVIDUAL KILL TIME (SEC) CODE MC1

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	0.8	0.9	1.3	0.7	0.5	9.0	6.6	4.6	2.0	2.4
3	X	1.1	1.2	0.8	0.9	1.3	5.2	15.6	2.8	2.3
5	0.9	X	0.6	0.4	0.4	1.6	6.6	6.8	X	X
AVG	.85	1.0	1.03	.63	.6	3.97	6.13	9.0	2.4	2.35

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	2.4	0.9	0.8	1.3	0.9	1.6	10.8	4.1	2.1	2.1
4	X	0.8	0.6	0.6	0.3	1.5	9.9	7.6	1.0	X
6	X	0.7	0.9	0.4	0.2	1.0	5.8	X	0.9	X
AVG	2.4	0.8	.77	.77	.47	1.37	8.83	5.85	1.33	2.1

TABLE 14. INDIVIDUAL KILL TIME (SEC) CODE MC2

STANDARD SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
1	X	5.5	0.7	2.5	2.4	5.4	39.1	15.2	1.5	1.5
3	X	1.6	10.1	2.6	1.9	1.8	7.7	X	1.5	X
5	X	1.3	3.4	0.8	0.9	1.8	7.9	7.2	1.4	X
AVG	X	2.8	4.73	1.97	1.73	3.0	18.2	11.2	1.47	1.5

NIGHT SIGHT

TARGET

RUN	1	2	3	4	5	6	7	8	9	10
2	4.7	5.4	X	4.9	3.7	3.4	3.5	4.2	1.2	1.2
4	X	1.1	0.9	0.6	0.4	2.3	X	X	2.2	X
6	3.7	1.5	1.6	0.5	1.2	2.0	21.1	X	3.5	X
AVG	4.2	2.67	1.25	2.0	1.77	2.57	12.3	4.2	2.3	1.2

TABLE 15. COMPOSITE OF AVERAGE SCORES

NIGHT SIGHT

TARGET

SHOOTER	1	2	3	4	5	6	7	8	9	10	TOTAL
AR1	2.27	1.93	2.1	1.6	1.27	3.6	5.5	6.13	1.75	4.0	30.15
AR3	1.5	1.73	1.05	1.43	1.07	2.9	2.33	2.1	1.63	2.05	17.79
NC1	1.47	1.27	1.2	0.7	.83	1.77	9.07	3.97	1.83	3.05	25.16
NC3	.9	1.47	1.4	.83	.83	1.8	2.77	8.13	1.27	2.7	27.1
AF1	1.5	1.43	1.85	1.23	.83	3.6	7.25	8.33	1.73	1.97	29.72
AF3	X	2.95	6.3	6.65	4.25	18.05	15.65	18.8	X	X	72.65
MC1	2.4	.8	.77	.77	.47	1.37	8.83	5.05	1.33	2.1	23.89
MC2	4/2	2.67	1.25	2.0	1.77	2.57	12.3	4.2	2.3	1.2	34.46
AR2	2.0	2.4	2.05	0.8	.85	2.57	4.65	4.6	1.77	2.2	23.89
AR4	2.17	1.6	0.8	1.13	.83	2.0	13.3	5.33	1.2	2.15	30.51
NC2	1.2	1.6	2.65	1.9	.93	2.97	5/1	X	2/1	X	11.25
AF2	X	1.93	1.45	1.33	1.3	2.5	4.45	15.73	2.07	2/43	30.76
AF4	1.63	2.05	0.8	1.78	.87	2.93	16.75	21.2	X	X	48.01
TOTAL	17.04	25.83	23.67	20.35	16.1	48.63	102.85	103.57	16.88	19.99	

/ = No valid comparison

TABLE 15. COMPOSITE OF AVERAGE SCORES (CONCLUDED)

STANDARD SIGHT

TARGET

SHOOTER	1	2	3	4	5	6	7	8	9	10	TOTAL
AR1	2.0	1.9	1.65	1.2	1.3	3.0	8.8	14.9	1.77	1.4	37.92
AR3	2.77	1.4	.85	.83	.87	1.87	3.1	2.37	1.27	1.1	16.93
NC1	2.43	2.17	1.6	0.9	.83	2.43	4.1	5.13	2.07	2.05	23.71
NC3	1.1	1.6	1.3	1.13	1.13	2.7	5.6	14.97	1.63	2.4	33.56
AF1	1.87	1.53	1.75	1.17	1.03	8.5	6.05	3.8	2.35	2.0	30.05
AF3	1/0	3.6	4.15	5.15	1.5	21.0	10.6	30.8	X	X	76.7
MC1	.85	1.0	1.03	.63	.6	3.97	6.13	9	2.4	2.35	27.96
MC2	X	2.8	4.73	1.97	1.73	3.0	18.2	11.2	1.47	1.5	46.7
AR2	3.8	2.2	2.5	1.23	.63	3.9	2.93	4.83	2.45	1.8	26.27
AR4	3.45	1.67	1.0	.93	1.33	2.3	3	4.07	1.7	1.45	20.9
NC2	.7	1.57	2.9	1.27	.6	10.3	X	12	X	2/2	17.34
AF2	1/57	1.5	2.3	1.77	2.13	5.87	4.43	20.6	2.6	X	41.2
AF4	1.6	1.9	1.2	3.9	.78	3.77	15.1	23.4	X	3/1	51.65
TOTAL	20.67	24.84	26.96	22.08	14.46	72.61	88.04	145.09	20.21	16.05	

/ = No valid comparison

TABLE 16. SUMS OF AVERAGE SCORES

SHOOTER	STANDARD SIGHT			NIGHT SIGHT	
	TARGETS 1 THRU 5	TARGETS 6 THRU 10	TARGETS 1 THRU 5	TARGETS 6 THRU 10	
AR1	8.05	29.87	9.17	20.98	
AR3	6.72	10.21	6.78	11.01	
NC1	7.93	15.78	5.47	19.69	
NC3	6.26	27.3	5.43	16.67	
AF1	7.35	22.7	6.84	22.88	
AF3	15/4	/	/	/	
MC1	4.11	23.85	5.21	18.68	
MC2	/	35.37	11/89	22.57	
AR2	10.36	15.91	8.1	15.79	
AR4	8.38	12.52	6.53	23.98	
NC2	7.04	/	8.28	/	
AF2	9/27	/	/	27.18	
AF4	9.38	/	7.13	/	
TOTAL	75.58	193.5	68.94	172.25	

/ = No valid comparison

TABLE 17. FIRST AND SECOND RUN
KILL TIME (SEC)
FIRST RUN NIGHT SIGHTS

NIGHT SIGHT

TARGET										
SHOOTER	1	2	3	4	5	6	7	8	9	10
AR2	/	3.6	2.5	/	/	2.7	/	6.0	1.8	2.7
AR4	3.7	2.2	/	1.5	0.8	4.3	3.2	10.2	1.4	1.4
NC2	1.7	2.6	2.0	2.4	1.2	4.9	/	/	/	/
AF2	/	2.7	1.3	1.4	/	2.2	4.9	7.1	2.1	2.1
AF4	1.9	2.3	0.9	1.2	0.7	3.3	6.2	31.9	/	/
TOTAL	3.6	13.4	6.7	6.5	2.7	14.1	8.1	23.3	5.3	

STANDARD SIGHT

AR2	3.8	3.8	2.9	2.0	1.0	3.9	3.7	9.6	3.1	/
AR4	/	2.2	2.1	0.3	0.7	3.9	5.5	2.4	1.7	/
NC2	0.8	2.1	2.1	1.1	0.8	3.8	/	12.0	/	/
AF2	0.7	1.5	1.1	1.4	0.9	2.5	1.9	2.1	1.9	/
AF4	1.3	1.8	1.2	1.3	0.9	/	/	/	/	/
TOTAL	2.1	11.4	7.3	4.1	2.4	14.1	7.4	14.1	6.7	

/ = No valid comparison

TABLE 18. FIRST AND SECOND RUN
KILL TIME (SEC)
FIRST RUN STANDARD RUNS

NIGHT SIGHT

TARGET

SHOOTER	1	2	3	4	5	6	7	8	9	10
AR1	2.7	2.3	1.9	1.8	1.4	4.7	12.9	5.9	1.6	/
AR3	1.5	2.2	1.2	1.6	1.5	4.0	3.1	3.4	2.3	1.8
NC1	1.3	1.7	1.5	0.7	1.1	3.1	16.5	3.3	3.1	2.8
NC3	0.4	1.7	1.5	0.8	1.5	2.4	3.8	5.5	1.1	/
AF1	1.1	1.7	1.9	1.6	0.9	/	/	6.6	1.4	1.4
AF3	/	3.4	2.9	9.9	3.6	29.9	21.0	10.5	/	/
MC3	2.4	0.9	0.8	1.3	0.9	1.6	10.8	4.1	2.1	2.1
MC4	4.1	5.4	/	4.9	3.7	3.4	3.5	4.2	1.2	1.2
TOTAL	9.4	19.3	11.7	22.6	14.6	46.7	71.6	43.5	12.8	6.1

/ = No valid comparison

TABLE 18. FIRST AND SECOND RUN
KILL TIME (SEC)
FIRST RUN STANDARD SIGHTS
(CONCLUDED)

STANDARD SIGHT

TARGET

SHOOTER	1	2	3	4	5	6	7	8	9	10
AR1	2.2	1.8	1.7	1.2	1.4	4.0	7.6	3.5	2.0	/
AR3	5.9	2.0	0.9	0.3	0.7	2.1	5.1	3.3	1.8	/
NC1	2.2	2.2	2.0	1.3	1.0	3.0	7.0	6.4	2.5	2.5
NC3	1.9	1.9	1.6	1.5	1.5	/	4.3	35.3	1.7	2.7
AF1	2.7	1.9	1.5	1.4	1.1	/	7.9	5.6	1.7	/
AF3	1.6	4.1	3.0	5.7	0.7	8.2	8.5	47.5	/	/
MC3	0.8	0.9	1.3	0.7	0.5	9.0	6.6	4.6	2.0	2.4
MC4	/	5.5	0.7	2.5	2.4	5.4	39.1	15.2	1.5	1.5
TOTAL	15.7	20.3	12	14.6	9.3	31.7	78.2	121.4	13.2	6.4

/ = No valid comparison

1. Summing the average scores of the eight shooters who had valid scores on all 10 targets, we find that five scored better with the night sights and three scored better with the standard sights.

2. The sum of the total average scores of the eight shooters who had valid scores on all targets is 203.21 seconds (2.54 average) for the night sight and 217.32 seconds (2.72 average) for the standard sight.

3. Summing the average scores for each shooter for all targets on which they had valid scores and comparisons, we find 10 shooters had better total average scores for the night sights and three shooters had better total average scores for the standard sights.

4. Summing the average score for each target on which a shooter had a valid score and comparison, we find the total average times were less for seven targets for the night sight and for three targets for the standard sight. The night sights being apparently better on targets 1, 3, 4, 6, 8, and 9 and the standard sights apparently better on 2, 5, 7, and 10. Note, however, that 4 and 5 are virtually identical, 7 and 8 are similar and 9 and 10 are identical.

5. Summing the average scores of the 10 shooters who had valid scores on the first five (short range) targets, we find six scored better with the night sight and four scored better with the standard sight.

6. The sum of the total average times for all shooters who had valid scores for the first five targets was 68.94 seconds (1.38 average) for the night sights and 75.58 seconds (1.51 average) for the standard sights.

7. Summing the average scores of the nine shooters who had valid scores on the last five (long range) targets, we find that five scored better with the night sights and four scored better with the standard sights.

8. The sum of the total average times for all shooters who had valid scores for the last five targets was 172.25 seconds (3.82 average) for the night sights and 193.15 seconds (4.29 average) for the standard sights.

9. Of the 12 shooters who had valid scores on the 113-foot range target 7, eight scored better with the standard sight and four scored better with the night sight. The total of the average times was 88.04 seconds (7.34 average) for the standard sights and 102.85 seconds (8.57 average) for the night sights.

10. Of the 11 shooters who had valid scores on the 150-foot range target 8, nine scored better with the night sight and two scored better with the standard sight. The total of the average times was 84.77 seconds (7.71 average) for the night sights and 114.29 (10.39 average) seconds for the standard sights.

11. Of the 10 shooters who had valid scores on the first moving target 9, nine scored better with the night sight and one scored better with the standard sight. The total of the average times was 16.86 seconds (1.67 average) for the night sight and 20.21 (2.02 average) for the standard sight.

12. Of the nine shooters who had valid scores on moving target 10 (identical to 9), six scored better with the standard sight and three scored better with the night sight. The total of the average times was 16.05 seconds (1.78 average) for the standard sights and 21.42 seconds (2.38 average) for the night sights.

13. The total of the average of the 19 valid scores against moving targets was 36.26 seconds (1.91 average) for the standard sights and 38.3 (2.01 average) for the night sights.

14. Summing the valid times for first runs of the five shooters who began with night sights, we find that six targets were scored better with standard sights, two were scored better with night sights, one tied, and one had no data.

15. Summing the valid times for first runs of the eight shooters who began with standard sights we find that seven targets were scored better with night sights and three were scored better with standard sights.

16. Comparing each individual target that had valid first run scores, we find the five shooters who began with night sights scored 16 targets better with standard sights and 12 better with night sights.

17. Comparing each individual target that had valid first run scores, we find the eight shooters who began with standard sights scored 33 targets better with standard sights and 32 targets better with night sights.

18. Looking at all shooters and all attempts to hit the running targets 9 and 10, we find that target 9 was missed nine times with night sights and 15 times with standard sights, and target 10 was missed 21 times with night sights and 24 times with standard sights.

SECTION III

CONCLUSIONS

The following conclusions can be made as a result of this evaluation:

1. Although one's intuition would dictate that clearly visible radio-luminescent pistol sights would enhance hitting capability at night, the data does not clearly support this contention.
2. Detailed study of the results show a slight inclination in favor of radio-luminescent night sights. However, in view of the scatter in the data and the fact that the "best" sight alternates on identical and nearly identical targets, this inclination is not believed to be statistically significant.
3. Given the lack of a significant tactical advantage under the conditions tested, the cost of such sights, and the relatively short (by military standards) half-life of Promethium (2.6 years), such sights are not a good military investment.

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